

FIELD APPLICATION OF SEWAGE AND SPENT MUSHROOM COMPOSTS IN CONJUNCTION WITH BASAMID, A FUMIGANT, TO CONTROL THE ROOT PATHOGEN, *CYLINDROCLADIUM SCOPARIUM*, IN FOREST NURSERY SOILS

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Cylindrocladium scoparium is a ubiquitous pathogen of many and varied plant hosts throughout the world. It is pathogenic to a wide range of economically-important plants and especially of hardwood and conifer nursery seedlings. This fungus is well established in the Pennsylvania Bureau of Forestry Nursery at Spring Mills, PA where this research is occurring. Many chemical and biological controls have been attempted at this nursery and elsewhere to lessen the incidence of diseases caused by *C. scoparium*, most having little or no affect. The persistence in soil of *C. scoparium* is because of its resistant, multicellular microsclerotia (MS). Consequently, this soilborne mot rot pathogen is an ideal organism for testing the efficacy of selected compost substrates (commercial human sewage and spent mushroom) and the soil fumigant, Basamid.

The potential benefits of various composts in controlling plant pathogens, like *C. scoparium*, and enhancing plant health establishes a need to investigate selected substrates which provide both nutrient and biological control properties to grow healthy forest tree seedlings. Composts reduce dependence on chemical fumigants such as methyl bromide, fungicides and inorganic fertilizers in nursery bed production systems. Compost amendments change substrate chemical and physical properties, and increase microbial diversity and activity. The microbial activities improve soil tilth, nutrient availability, and potential for suppression of soilborne plant pathogens. Although suppression mechanisms of action are not clearly understood, the application of composted substrates introduces microorganisms and naturally-derived chemicals that ham the potential to inhibit, parasitize, kill, or otherwise attenuate the activity of specific soilborne pests of plants. Human sewage compost (HSC) and spent mushroom compost (SMC), in conjunction with Basamid were selected to determine whether they would affect the growth and survival of *C. scoparium* in nursery soils at the Penn Nursery.

The Composts and Basamid (field study only) were used separately and together ¹⁰ to evaluate their fungal suppression. efficacies. The two composts are licensed and commercially available, and are routinely used by Landscape maintenance and greenhouse production companies. Basamid is a soil fumigant which breaks down in the soil to form methyl isothiocyanate and other volatile liquids which kill soil microbes on contact. Soils containing MS of *C. scoparium* were removed from the Penn Nursery and tested in the laboratory at California University of PA (CUP) with the human and mushroom compost amendments. Field samples of control, Basamid and compost amended soils were randomly collected and returned to CUP for processing. The geranium baiting procedure, a differential selective medium and a soil chemical procedure were used to qualitatively assay for the cylindrocladia. A quantitative wet-sieving procedure was also employed to enumerate soilborne microsclerotia. Field data were analyzed using a random block design three way ANOVA. Multiple means

comparisons between all samples were determined with the Scheffe F-Test (Table 1). We compared soils naturally-infested with the cylindrocladia (controls) to infested soils with varying compost amendments. All

amended soils showed varying degrees of suppression, and when the experimental samples were averaged the amount of suppression or degree of inhibition/death of the cylindrocladia was clearly evident. Figures 1 and 2 provide evidence of the fungal suppression in the laboratory with a HSC/SMC soil mixture providing the best results. These laboratory data of compost amendment suppression of the cylindrocladia showed the need to continue our research in the field. There were significant differences in the recovery of *C. scoparium* from soils of different amendments when compared to the controls and Basamid (Fig. 3). Figure 4 provides data that the composts at different volumes were suppressive over a two year period with the 60 ton application approximating Basamid suppression at the end of season collections. The controls (no amendments) were significantly different from the composts and Basamid. In several months, regardless of the rate application of composts, the suppression of this fungus was below 50% recovery. The duration of the amendments in the soil (time) appears to be the most significant variable regardless of the compost amendments at 20, 30 and 40 tons per acre (t/a) applications (Figs 4 and 5). Another important variable was the mixture of amendments. On the basis of the data, the 25/75 ratio of amendments at 30 or 40 t/a appear to be optimal mixes for maximum suppression over time. This is important because we want to use as little of the HSC in our mix to reduce heavy metal loading in the nursery soils. Figure 6 provides various compost mixtures showing effective suppression, which validates our contention that 25/75 ratio would suppress the cylindrocladia without using excessive HSC.

All of our Figures and Table 2 show that Basamid effectively suppresses *C. scoparium* initially and throughout the field samplings. However, Basamid is a soil sterilant which eliminates much of the natural soil microbial biota. Therefore, we used Basamid in conjunction with the composts and with forest soils to establish new microbial populations. Figure 7 shows that Basamid with the composts is equally as effective as Basamid alone. We have also used Basamid, both composts and forest soil mixtures with effective *C. scoparium* suppression (Fig 8). On the basis of our investigations we concluded that *C. scoparium* soilborne populations were dramatically reduced in our laboratory and field studies and this reduction could be maintained for several months. The reduction in soilborne MS where the composts and/or Basamid were placed was dramatic. Soils with initial MS numbers of greater than 10 per gram of soil were reduced to less than two. The less soil MS the, more probable it will be to grow healthy seedlings. We also demonstrated that low loading with HSC, 25/75 ratio HSC/SMC is effective in *C. scoparium* -suppression.

The field studies of 1997 are presently being analyzed. Our 1998 study will be to confirm previous data and determine the most effective way(s) to use Basamid in conjunction with the composts and forest soils. We will also attempt to determine how the amendments affect forest tree seedling health and vigor and whether the reduction in the cylindrocladia in nursery soils leads to a lessening of seedling root rot and damping off.

TABLE 1
One Factor ANOVA
Random Block Design(RBD)
Compost Treatments

Comparison	Mean Diff.:	Scheffe F-test	Dunnett t:
10:90@40t vs 50:50@40t		11	1
10:90@40t vs 25:75@40t		1	4.00E-03
10:90@40t vs 100:0@40t		10	1
50:00@40t vs 25:75@40t	-10	1	2
50:50@40t vs 100:0@40t		-1	4.00E-03
25:75@40t vs 100:0@40t		9	5.00E-01

- Significant at 95%

One Factor ANOVA – RBD
Control Vs Basamids

Table 2

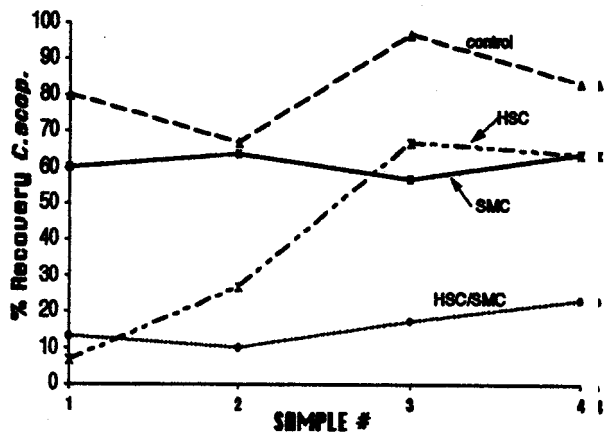
Comparison:	Mean Diff.:	Scheffe F-test	<u>Dunnett t:</u>
control vs basamid	76	25*	17
basamid vs bas.+25:75@30t	-3	3E-02	1
basamid vs bas.+25:75@40t	-3	3E-02	1
bas.+@30t vs bas.+@40t	0	0	0

* Significant at 95%

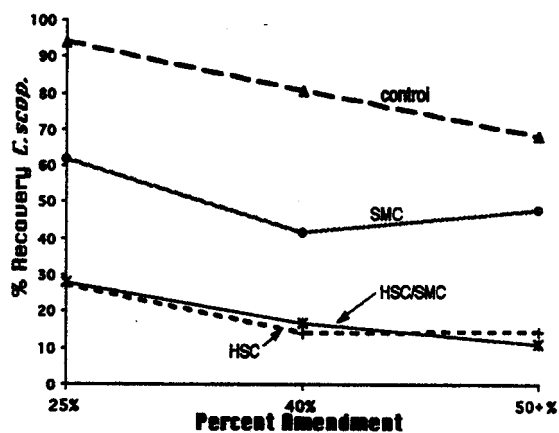
KEY

HSC=HUMAN SEWAGE
COMPOST
SMC= SPENT MUSHROOM
COMPOST
ALL RATIOS eq.25:75
ARE HSC:SMC

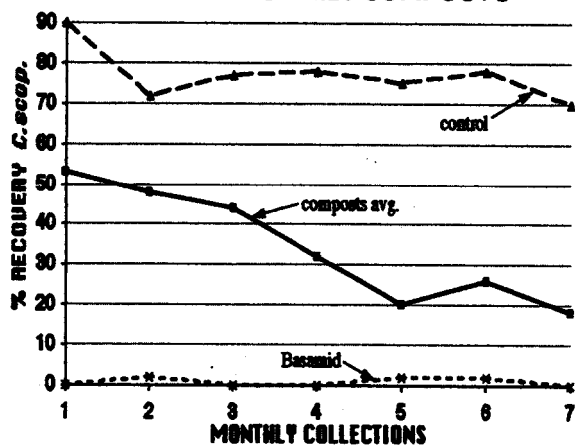
LABORATORY STUDY **FIG.1.1**
CONTROL vs COMPOST ADDITIONS



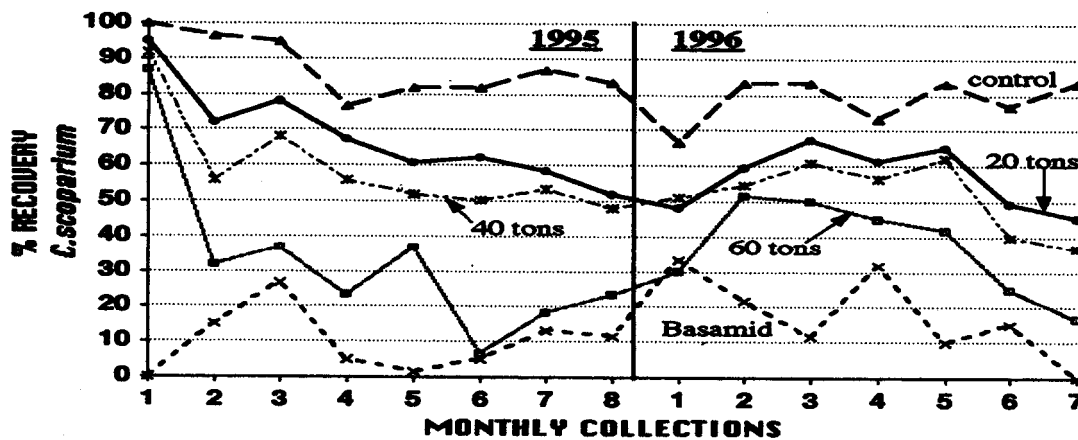
LABORATORY STUDY **FIG.2**
COMPOST ADDITIONS TO SOIL



'96 BEDS **FIG.3**
CONTROL/BASAMID/COMPOSTS

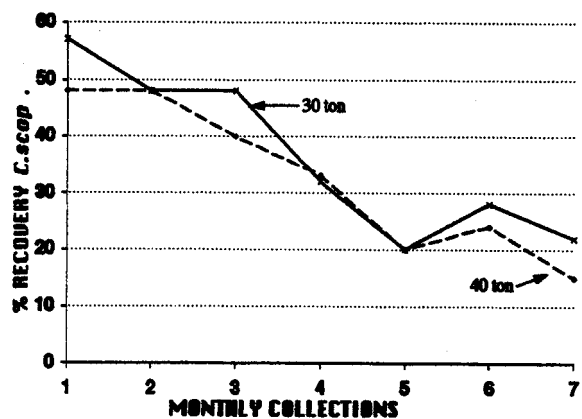


'95 BEDS - year 1 + year 2 **FIG.4**
20/40/60 ton/acre avgs.



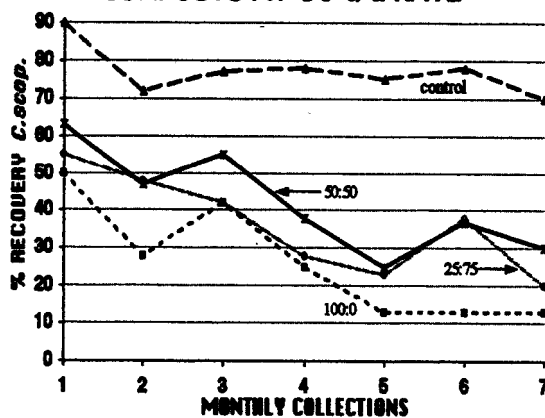
**'96 BEDS
40 TON/ACRE vs 30 TON/ACRE**

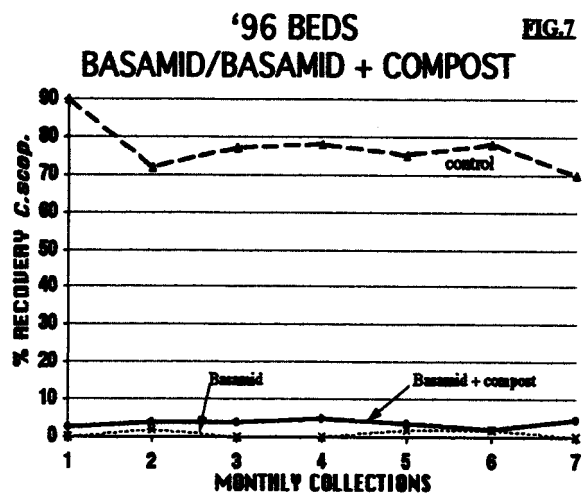
FIG.5



**'96 BEDS
COMPOSTS AT 30 t/a RATE**

FIG.6





MONTHLY COLLECTIONS

